U. S. DEPARTMENT OF AGRICULTURE,

DIVISION OF ENTOMOLOGY,

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THE HOP PLANT-LOUSE

AND THE

REMEDIES TO BE USED AGAINST IT.

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LETTER OF SUBMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, June 11, 1891.

SIR: I have the honor to submit for immediate publication this emergency bulletin, covering the main facts in the life-history of the Hop Plant-louse and the best remedies against its ravages. This has been drawn up at your instance, in view of the facts that the report for 1888 is no longer to be had for distribution, and that urgent demands for information are being made of the Department. The insect is appearing in alarming numbers in the hop regions of New York the present week; while the hop growers of Oregon and Washington are also greatly exercised about it the present season.

Respectfully yours,

C. V. RILEY,
Entomologist.

Hon. J. M. RUSK,
Secretary of Agriculture.

THE HOP PLANT-LOUSE.

(*Phorodon humuli.*)

LIFE HISTORY.

Wherever it occurs, whether in England or on the continent of Europe, in New York, Wisconsin, or on the Pacific coast, the Hop Plant-louse has substantially the same life-round. The eggs are laid in the fall on different varieties and species of the Plum, both wild and cultivated. They are small, glossy, black, ovoid, and are attached to the terminal twigs especially in the more or less protected crevices around the buds (fig. 1). From this egg there hatches in the spring, about the time when the plum buds begin to burst, a stout female plant-louse, known as the stem-mother, which differs from the summer individuals by having shorter legs and shorter honey-tubes (fig. 2). She gives birth, without the intervention of the male, to living young, and this method of propagation continues till the last generation of the season. The second generation grows to full size and gives birth to a third, which becomes winged (fig. 3) and develops after the hops have made considerable growth in the yards. The winged lice then fly from the plums to the hops, deserting the plum trees entirely and settling upon the leaves of the hops, where they begin giving birth to another generation of wingless individuals.

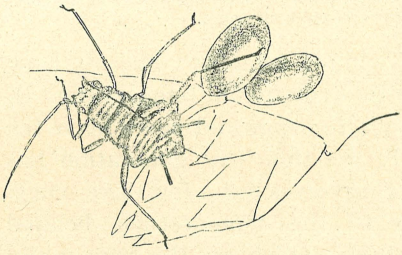

FIG. 1.—Winter eggs of the Hop Plant-louse, and shriveled skin of the sexual female which laid them—enlarged.

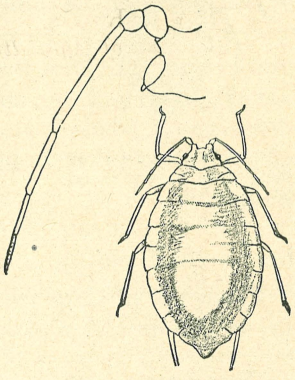

FIG. 2.—The Hop Plant-louse, stem-mother, with enlarged antenna above—enlarged.

These multiply with astonishing rapidity * for from five to twelve generations, carrying us in point of time to the hop-picking season.

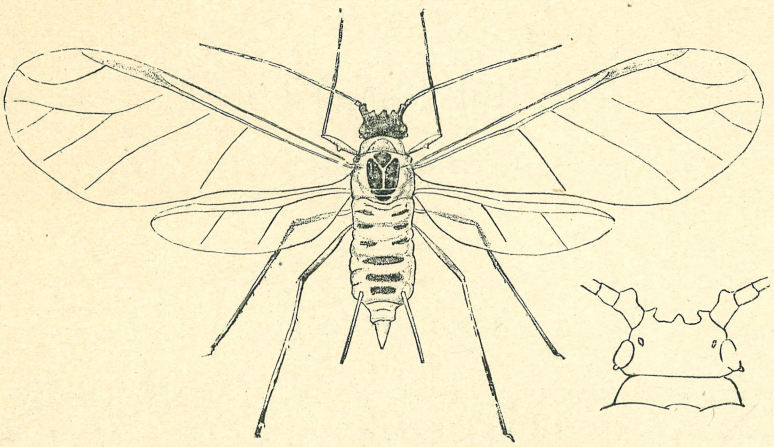

FIG. 3.—The Hop Plant-louse, third generation on Plum—the generation which flies to the hop—enlarged; head below at right—still more enlarged.

There then develops a generation of winged females which fly back to the plum tree and give birth to the true sexual females (fig. 4), which never acquire wings and never leave the plum tree. By the time this generation has matured, which involves but a few days, varying according to the temperature, belated winged individuals, which are the true males (fig. 5), fly in from the hop fields. These fertilize the wingless true females upon the plum leaves and these soon thereafter lay the winter eggs. Thus there is but one generation of sexed individuals produced and this at the close of the life-round—the females wingless on plum trees; the males winged on hops. All intervening generations are composed of virgin females only (parthenogenetic).

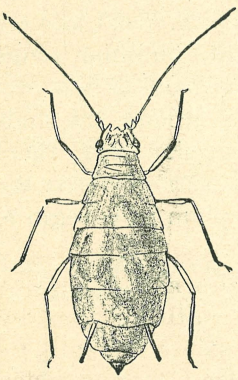

FIG. 4.—The Hop Plant-louse, true, sexual female—enlarged.

This is the invariable round of the insect's life.

REMEDIES.

From the life history just given three important facts are obtained: (1) It will pay to make a preventive application of some one of the

* Each female is capable of producing on an average about one hundred young, at the rate of three per day under favorable conditions. Each generation begins to breed about the eighth day after birth, so that the issue from a single individual runs up, in the course of a summer, to trillions. The issue from a single stem-mother may thus, under favorable conditions, blight hundreds of acres in the course of 2 or 3 months.

mixtures mentioned further on, with apparatus there described, to all plum trees in the neighborhood of hop yards, either (*a*) in the spring before the appearance of the first winged generation and its consequent migration to hop, or (*b*) in the fall after hop-picking and after the lice have once more returned to the plum and are making their preparations for the laying of winter eggs. The latter time will, perhaps, be preferable, for the reason that in the fall the plum trees are less susceptible to the action of the washes and a stronger solution can be applied without damage to the trees.

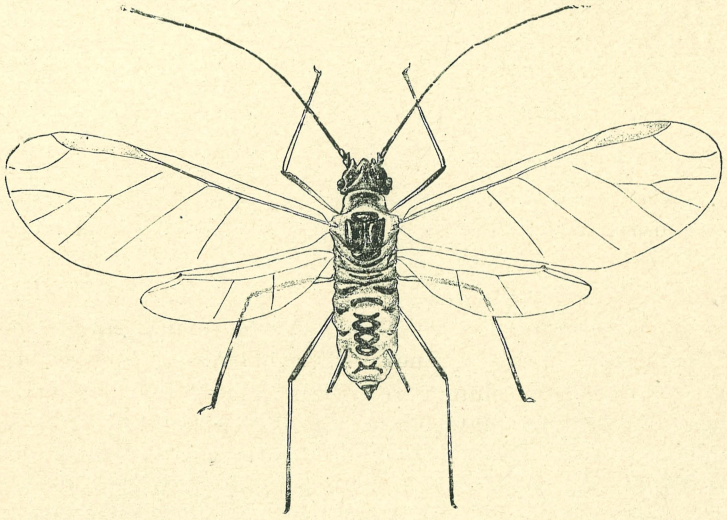

FIG. 5.—The Hop Plant-louse, male—enlarged.

(2) All wild plum trees in the woods through a hop-growing country should be destroyed. (3) The hop vines should be either burned or thoroughly drenched with kerosene emulsion as soon after the crop is harvested with a view of killing the males, and thus preventing impregnation of the females. If these measures are carefully followed comparative exemption from lice may be confidently expected.

At the present time it is too late for preventive work, and the only thing which can be done to lessen the damage to the crop is to destroy the lice upon the vines by spraying with an insecticide mixture. Such spraying can, with care, be made quite effective, and the individual hop grower will have the satisfaction of knowing that whatever work he does upon his own yard will not be thwarted by the carelessness of neighbors, *as during the summer the lice can not migrate except by crawling from one yard to another.*

Substances to be used.—Of all the different substances experimented with in 1888 none gave more satisfaction than properly prepared kerosene emulsions and fish-oil soaps.

Formula for kerosene emulsion.

Cheap kerosene	pints	8
Water	do	4
Soap	pound	½

Dissolve the soap in the water and add (boiling hot) to the kerosene. Churn the mixture by means of a force pump and spray nozzle for 5 or 10 minutes. The emulsion, if perfect, forms a cream which thickens upon cooling, and should adhere without oiliness, to the surface of glass. Dilute one part of the emulsion with 25 parts of water.

A common grade of kerosene, which is good enough for this work, can be bought in most localities at 8 cents a gallon by the barrel, and the soap used can be made for 1 cent a pound. This would make the batch given above cost 8½ cents, and diluted with 25 gallons of water to 1 of the emulsion would make 38½ gallons of wash. At this rate 100 gallons will cost 20 cents.

Formula for fish-oil soap.

Hirsch's Crystal Potash Lye	pound	1
Fish-oil	pints	3
Soft water	gallons	2

The lye is dissolved in water, and when brought to the boiling point the oil is added. The batch should be cooked about two hours. When done it should be filled up to make up for the evaporation by boiling, and there will be about 25 pounds as a result of the formula. When cold it can be cut and handled in cakes.

The fish-oil will cost about 36 cents per gallon in New York City, the lye 9 cents per pound. This batch of 25 pounds thus costs a little under 1 cent per pound. A strong suds made at the rate of 1 pound of this soap to 8 gallons of water will be found a uniformly safe and satisfactory wash to use, killing the lice and not harming the vines. After standing three days, however, the suds will lose its efficiency.

Spraying apparatus.—In a large hop yard it will be necessary to have a pump which must be drawn by horse-power. Such an apparatus we have shown by fig. 6, taken from the annual report of this Department for 1888. The important points are, a good double-acting single-cylinder force pump and a good spraying nozzle. Pumps of this character can be purchased from the Nixon Nozzle and Machine Company, Dayton, Ohio ($20), the Field Force Pump Company, Lockport, N. Y. ($12), the Gould Manufacturing Company, Seneca Falls, N. Y. ($14).

The best nozzles are the Cyclone or Riley nozzle, which can be bought from Thos. Somerville & Sons, Washington, D. C. (50 cents), or the Field Force Pump Company, Lockport, N. Y., and the Climax nozzle, which can be bought of the Nixon Nozzle and Machine Company, of Dayton, Ohio ($1).

FIG. 6.—Apparatus for spraying hop yards.

Proper pumps already mounted on tanks or barrels ready for use can be purchased from either the Field Force Pump Company or the Gould Manufacturing Company.

Any hop-grower, however, can readily prepare the apparatus as shown on fig. 6, after the pump and nozzle have been purchased.

The bench to which the pump is fastened is made to fit the round of the barrel and hooks down to the sides and ends, as shown in the figure. The pump is bolted to this bench and then inserted through an opening in the barrel. It is not a matter of any importance how the barrel or tank is supported on the boat or sled, but a skid can easily be made consisting of 4 by 4 inch scantling 2 feet 6 inches long, the bottom pieces being placed 18 inches apart and the top pieces 13 inches, and bolts are put through each corner. The top pieces should be rounded on the inner side to meet the rounded sides of the barrel. To the bottom of the pump cylinder a flexible hose is fitted of sufficient length to reach to the bottom of the tank. This supply pipe should always be covered with a strainer. The method of drawing the tank over the fields by means of a flatboat is cheap and convenient. A barrel mounted upon runners can easily be drawn by one horse over cultivated ground. All tanks should be provided with a strainer through which the liquid is poured. This is of considerable importance and will help very much to prevent the clogging of the nozzles. The ordinary spraying pumps are fitted up with one-half to three-quarter inch heavy hose; this, however, is too heavy, and a practicable length of it can not be used. It is better to buy a good cloth insertion three-eighths or one-quarter inch rubber tubing, which will answer every purpose and will be light enough to be elevated on a pole (a bamboo fishing-rod will answer the purpose and will be the lightest substance which can be found), as shown in the figure.

To revert once more to the subject of nozzles, it is very important to spray the undersides of the leaves, and the undersides of the lower leaves can not well be reached by an end-discharge nozzle like the Climax. The Cyclone or Riley nozzle is a side-discharge nozzle, and by its use this kind of spraying can be readily done.

It will be somewhat expensive to construct an apparatus like the above, but it will last for a number of years if well made, and will b applicable to many other uses.

In small hop yards a knapsack pump will answer the purp as well. Three very good and substantial ones are on t as follows: The Galloway Sprayer, manufactured Trusheim, 2026 Fourteenth street, Washington, Knapsack, manufactured by the Field Force Lockport, N. Y., sells for the same price, Adam Weaver, of Vineland, N. J., for